IN THE DESCRIPTION

In order to provide better description of the invention and its background please insert the following text in the description. It is believed that the added description text is covered by the subject matter disclosed in the original application. No claims will be made on the basis of the added description text.

In the line 6, page 2 please insert after "April 2000": **and US serial No. US serial No. 09/566506 "Fire Prevention and Fire Suppression Systems for computer cabinets and fire-hazardous industrial containers", filed 8 May 2000.**

After the line 24, page 8 please insert:

Fig. 28 shows the implementation of Aircraft Fire Suppression System into aircraft cabin design.

Fig. 29, 30, 31 and 32 illustrate schematically the working principle of the AFSS.

Fig. 33 illustrates the variance in oxyhemoglobin's saturation at 10% O2 in inspired air containing ambient atmospheric CO2 concentration in one case and increased up to 4% CO2 content in another case.

After line 25 on page 38 please insert:

Advanced Aircraft Fire Suppression System

The Aircraft Fire Suppression System (AFSS) described in the rest of this document represents a cost-effective, highly reliable and practical solution to the fire suppression problem on board any aircraft, especially present-day passenger airplanes that require pressurization at 2-3 km altitude, which represents a modification of the embodiment shown earlier on Fig.21.

Fig.28 shows a schematic cross-sectional view of a passenger aircraft cabin 281 having AFSS (Aircraft Fire Suppression System) gas agent storage container 282 installed in the upper body lobe behind the ceiling.

Some aircraft designs do not provide enough space for installing container 282 in the upper body lobe. In such cases container 282 may be installed in the lower body lobe or anywhere in the aircraft body. Container 282 may have any form and appearance—it may be installed in multiple quantities as insulation panels under the aircraft's skin. For an existing aircraft, in order to reduce the cost of

the conversion, it can be installed in one of the standard airfreight containers that fit in the aircraft's cargo bay.

The most preferred embodiment of the container 282 consists of a light rigid plastic, metal or composite skin 283 containing inside a soft inflatable gas storage bag 284 made from a thin and lightweight synthetic or composite material. During normal aircraft operation storage bag 284 is inflated and contains under minor pressure a breathable fire suppressive agent consisting of hypoxic (oxygen-depleted) air with an increased carbon dioxide content. Using more accurate terminology, the AFSS fire suppression agent consists of a mixture of oxygen, nitrogen and carbon dioxide with possible addition of other atmospheric gases, wherein nitrogen can be replaced in part or completely with an other inert gas or gas mixture.

The oxygen content in the breathable hypoxic fire-suppression atmosphere of the pressure cabin after the fire suppression agent being released must be below Hypoxic Threshold of 16.8%, and preferably in the range from 14%-16% (depending on the pressurization level inside aircraft) or lower for some special cases described further below. The carbon dioxide content in this internal atmosphere should be approximately 4-5%. The rest of the gas mixture (79%-82%) consists of nitrogen and other atmospheric gases.

Fig. 29 illustrates schematically the working principle of the AFSS that is tied directly to smoke or thermal detectors 285 distributed throughout the pressure cabin 281. A signal from a detector 285 opens a local automatic release valve 286 (or all at once, if desired) and is also transmitted to the main control panel, which automatically turns on blower 287 that operates the AFSS. In order to increase reliability of the system, a signal from any detector 285 should open all release valves 286. However, in some cases, a detector 285 that detects fire or smoke first may open only a local valve or group of valves 286.

The opening of release valves 286 results in the rapid introduction of the hypoxic fire suppression agent from storage bag 284 into pressure cabin 281. At the same moment a high efficiency blower 287 sucks up air contaminated with smoke from the cabin through the air-collecting system 289 and pressurizes it in container 282 deflating bag 284 completely and forcing all amount of the hypoxic fire agent out of the bag 284 and into cabin 281, via conduit 288 and release valves 286.

As an option, in order to remove traces of smoke and other pyrolysis products from the cabin air, the air-collecting system 289 operated by blower 287 may continue to operate even after bag 284 is completely deflated. In this case the pressure inside container 282 will rise until a certain value

controlled by an optional relief valve (not shown here) releasing excessive gas mixture into outside atmosphere.

During normal aircraft operations, container 282 communicates with pressure cabin 281 through the blower 287, which allows equalizing its pressure during a flight.

It is recommended that hypoxic agent should be released into all cabin accommodation simultaneously. However, in order to reduce the size of container 282, the release of hypoxic fire agent can be limited to the space in which smoke or fire was detected. Given AFSS's reaction time of less than one second, this should be more than sufficient to suppress a localized fire. If needed, pressure cabin 281 can be also separated into different sections by dividing curtains as described in embodiments shown on Fig. 11, 15 and 16.

Discharge nozzles 286 are equipped each with a release valve having an electrical or electro-explosive initiator. Manual operation is also possible in case of power failure--a crewmember can pull open the nearest release valve, if needed. Suitable solenoid or burst disk-type valves, initiators and detectors are available from a number of fire equipment suppliers.

Relief valve 290, generally installed in an aircraft, provides a guarantee that the barometric pressure inside cabin 281 will be maintained within safety limits during release of the hypoxic fire-extinguishing agent. It is necessary to shut down the ventilation system (not shown here due to its complexity) of the cabin 11 when AFSS is initiated. The ventilation system can be turned on again after 5-10 minutes, which is more than enough to detect the suppressed fire source and prevent it from reigniting.

While Fig.29 shows the AFSS at the beginning of the deployment, the Fig. 30 shows the same embodiment close to the end, when gas storage bag 284 is almost deflated and the fire extinguished.

In order to simplify the AFSS, the local discharge nozzle valves 286 may be replaced just by one main valve in the upper portion of the delivery piping 288 as shown on Fig. 31 and 32.

The embodiment presented on Fig. 31 and 32 shows the same solution, but using two inflatable bags 302 and 303 installed in a non-airtight container or frame 304 that is only needed in order to hold both bags in place. When AFSS is deployed, the blower 307 pumps air from the cabin 301 inside bag 303 that is initially deflated. While inflating, the bag 303 applies pressure on bag 302 that already starts discharging the hypoxic fire-suppressive agent through valve 311 and nozzles 306. Valve 311

opens by a signal from fire/smoke detectors 305 or manually by a crewmember. Inflating bag 303 will completely deflate bag 302 allowing all the gas out of the system. Pressure relief valve 310 will guarantee desired pressure in cabin 301.

The breathable fire-suppressive agent should be available on board of the aircraft in an amount sufficient for a complete air exchange in the cabin, if possible. The initial oxygen content in the fire agent and its storage pressure in bag 14 may vary. This depends on the storage space availability on board of aircraft. In any case these parameters are calculated in such a way that when the fire agent is released, it will provide a fire-suppressive atmosphere on board with an oxygen content of about 15%. The gas storage pressure may vary from the standard atmospheric up to 2-3 bar or even higher.

Once the AFSS is deployed, the cabin's fresh air supply system must be automatically shut down. It is also recommended not to use it during the remainder of the flight. This will allow retaining the fire-extinguishing atmosphere in case the fire resumes, which usually happens during electrical incidents. Fresh air may be added in exact controlled amounts in order to keep the oxygen content in the cabin atmosphere between 15% and 16%

The hypoxic fire-extinguishing agent may be generated in flight, if needed, by an on-board hypoxic generator manufactured by Hypoxico Inc., or the ground service vehicle 222 shown on Fig. 22 can refill the system. This vehicle is equipped with a hypoxic generator and cylinders with stored carbon dioxide. The working principle of the hypoxic generator is explained entirely earlier in this document and in the previous patent applications provided above. Vehicle 222 provides ground service on AFSS and, if needed, refilling of the system with breathable fire-extinguishing composition. This composition consists of a mixture of hypoxic air gases generated at site from ambient air and carbon dioxide added to the mixture. Hypoxic generator utilizes the molecular-sieve adsorption technology that allows extracting a precise part of oxygen from ambient air and providing oxygen-depleted air with exact oxygen content. The concentration of oxygen in the fire-extinguishing composition may vary from 16% down to 1% or even lower, and is always predetermined so that when released, the atmosphere in the aircraft's cabin will contain approximately 15% of oxygen (may be lower for military vehicles).

Hypoxic atmosphere with a 15% oxygen content at barometric pressure of 2.5 km is absolutely safe for general public (even without supplemental oxygen) for the time needed to localize and control the fire source (at least 15 minutes) or for the aircraft to descend to a lower altitude, which will increase barometric pressure on board and counterbalance effect of hypoxia.

However, the addition of only 4-5% of carbon dioxide to the hypoxic gas mixture will allow retaining a fire-suppressive hypoxic atmosphere for hours without negative side effects on passengers' health.

The diagram presented on Fig. 33 illustrates the variance of hemoglobin's oxygen saturation with as it relates to the drop in oxygen content in inspired air from ambient 20.9% to 10% under the following two conditions:

a) At ambient atmospheric carbon dioxide content of 0.035% and

b) At increased carbon dioxide content of 4%

This illustration is confirmed by the results of an extensive research "CO2 – O2 Interactions In Extention Of Tolerance To Acute Hypoxia" conducted for NASA in 1995 by University of Pennsylvania Medical Center (Lambertsen, C.J.)

Curve R illustrates a drop in arterial oxyhemoglobin saturation from 98% to the level of about 70% during exposure to 10% O2 in the inspired air having ambient atmospheric carbon dioxide content.. Curve S represents physiological response to restored normocapnia in hypoxia when 4% CO2 was added to the inspired hypoxic gas mixture having 10% O2. It clearly shows the effectiveness of carbon-dioxide-induced acute physiologic adaptation to hypoxia.
According to the NASA research report: "…carbon dioxide can increase brain blood flow and oxygenation, by dilating brain blood vessels. This increased blood (oxygen) flow provides an acute, beneficial adaptation to otherwise intolerable degrees of hypoxia"
"In hypoxic exposures, an increase in arterial carbon dioxide pressure can sustain brain oxygenation and mental performance."
All this confirms that an addition of 4-5% CO2 to the breathable hypoxic fire-extinguishing agent can provide guarantee that the use of such agent onboard of an aircraft is absolutely safe. Moreover, a number of researchers confirm that exposure to such hypercapnia level continuing for many days does not provide any harm to the human organism.
Fig. 34 shows a diagram representing an average physiological response to the exposure to the invented breathable hypoxic fire-suppressive composition at an altitude of 2.5 km, which corresponds to the barometric pressure on board a modern passenger aircraft due to its pressurization at this altitude.

During flight, an average oxygen saturation of hemoglobin is about 96%. After about 20 minutes following the release of the breathable hypoxic fire-suppressive gas mixture, the arterial oxyhemoglobin saturation may drop on average to 93%, as shown by curve Q on the diagram,

provided that the gas mixture contains about 15% O2 and 4% CO2. Such an insignificant drop in oxyhemoglobin saturation can be observed during a moderate exercise at sea level, which is absolutely safe.

The AFSS allows maintaining hypoxic fire-retarding environment during the rest of the flight, if needed, by simply keeping the fresh-air-intake and ventilation systems of the pressure cabin off. Fresh air can be added automatically in limited amounts in order to maintain oxygen content inside the aircraft cabin at a level of about 16%. Such automatic system can be easily built by implementing an oxygen transducer.

At the present time new composite materials have allowed stronger and lighter aircraft to be designed without the need for reducing interior atmospheric pressure by pressurizing at higher altitudes. Such airplanes will provide a standard atmospheric pressure on board during the flight and can also handle a slight increase in internal pressure. A deployment of the AFSS on board of such aircraft will induce an average drop in arterial oxyhemoglobin from 98% to about 95%, which would be hardly noticeable by a passenger.

Please replace the final portion of the description from line 28 on page 38 until line 4 on page 39 with the following text:

The invented Hypoxic FirePASS, AFSS and breathable hypoxic fire-extinguishing compositions can be employed in any enclosed human occupied space, including but not limited to: rooms for data processing, telecommunication switches, process control and Internet servers, banks/financial institutions, museums, archives, libraries and art collections, military and marine facilities, passenger/military aircraft, space vehicles/stations, underground/underwater facilities; marine vessels; facilities operating with inflammable/explosive materials, nuclear power plants, transportation tunnels and vehicles, apartment and office complexes, hospitals, private homes and other isolated human-occupied objects for living, working, travel, sport, entertainment and further human activities. More information will be provided on the Internet at: www.firepass.com.

IN THE DRAWINGS

Please insert 5 additional sheets of drawings containing Fig. 28 – 34.